Earned Value Project Management . . . an Introduction

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Earned value is a project management technique that is emerging as a valuable tool in the management of all projects, software projects in particular. In its simplest form, earned value equates to fundamental project management. Here the authors describe the technique in a storybook form. It is not necessarily a true story . . . but it could be.

ONCE UPON A TIME there was a young man who wanted to be a project manager. Don't ask us why.

In school the young man took the most challenging of the technical subjects, but he also liked to manage things. He graduated with a master's degree in a technical discipline and immediately went to work for a small but fast-growing high-tech company. This company was a leader in developing new products for its niche of the market. The company had just gone public and its initial public offering of stock was a huge financial success. He knew he had joined the right company. All he wanted was his chance at bat. He wanted to be a project manager.

A year went by and he had yet to receive an assignment of any consequence. He was becoming discouraged. He considered updating his resume to start looking around. If his present employer did not recognize his talents, perhaps others would. He did not have time to waste.

One day as he walked down the hall the chief executive approached him. She inquired as to how he was getting along. Then she asked him, *"How would you like an important assignment as manager of a development project?"* The young man could hardly convey his enthusiasm. Then the CEO said, *"If you are interested, call my secretary and get on my calendar for the first thing in the morning."* As she left, she commented to him, *"This is an extremely important project for the company, and I think you could manage it nicely. See you then."*

Our young man got little sleep that night. Imagine, his chance to manage a project — to be a project manager. He was in the chief executive's office 30 minutes before she arrived. When they met she started by saying, *"This is one of the most important potential new products we have in the pipeline, but it needs some innovative thinking, and that is why I think you would be the right person to take this on. I need fresh ideas incorporated into this product."*

She outlined the concept for the new product. It was exactly the type of work he had prepared himself to do. She asked him to gather a half dozen cross-functional people from within the company and to prepare a project plan for her approval. *"If you have any problem getting people, use my name to break them loose. I don't want stonewalling by anyone; this product is important to our future growth."*

Then she closed the meeting by saying, *"The time to market is most critical on this project; I know others are working on it, and I want to be first into the marketplace."* The young man got the message, and it was better than he had ever hoped. On his way out she mentioned another issue.

"I would also like you to use a technique I have heard about but cannot seem to get started here: earned value management. Have you ever heard of it?"

"Yes, of course. We studied it in school and I think it would work well on this project," he replied.

"Good. I look forward to seeing your performance plan," she told him.

The young man circulated within the company and got commitment from the right people to do the planning. This was a young start-up company so the "brick walls" so pervasive in older, more established companies had not set in. All he had to do was mention that the boss was behind this assignment and he got his people. He did not even have to describe the details of the assignment, they all knew it was high priority.
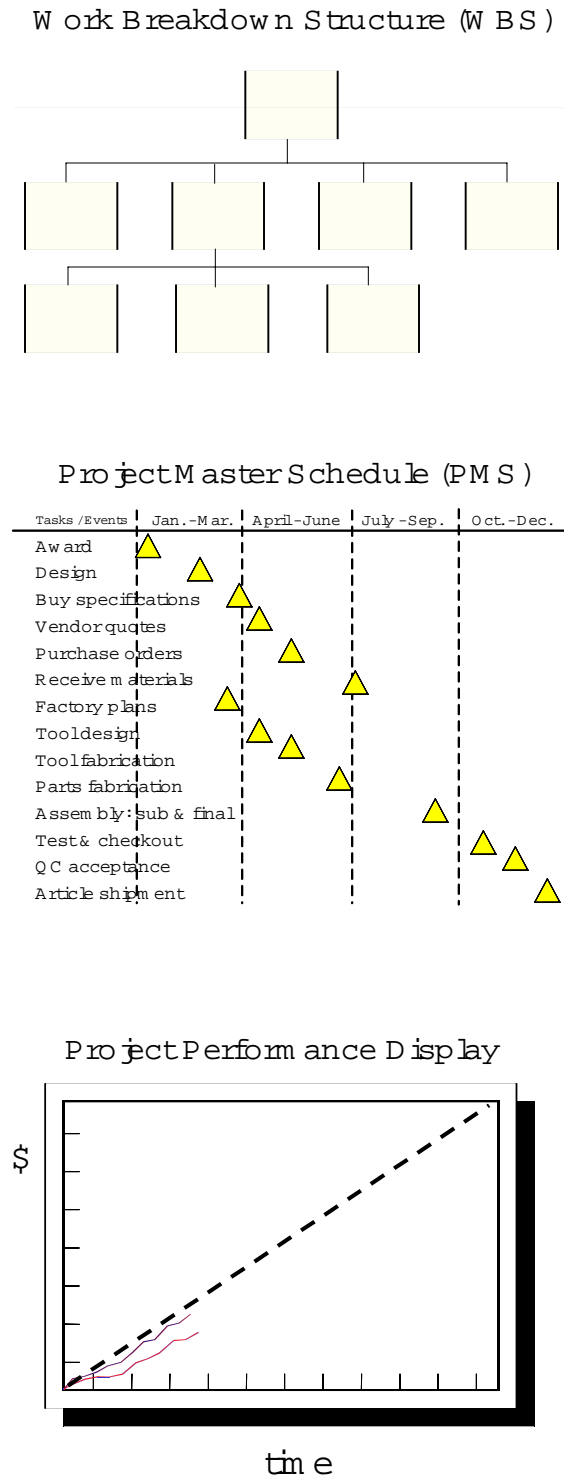
Planning for Performance Measurement

His team met at his apartment to prevent interruptions and phone calls. *"It shouldn't take us very long to put a plan on paper,"* was his opening remark. They spent the day conceptualizing and defining the project. After he solicited the team's ideas, he planned to prepare the final plan for review and approval of the team, prior to submittal to the CEO. The project manager wanted everyone to buy into the project plan. They all knew exactly what was required in order to employ earned value performance measurement. It was classic "Project Management 101."

First they had to define what constituted 100 percent of the assumed project scope. They used a Work Breakdown Structure (WBS) diagram. Next they would decompose the project scope into measurable tasks, each with an estimated value, and assign responsibility for actual performance to some functional manager within the company. They used a WBS dictionary to record their thoughts. They knew that their project had 10 units to develop and test, and that each unit would require about the same level of resources to accomplish.

Next they would take the work, broadly conceptualized from the WBS diagram and dictionary, and prepare a detailed plan and schedule for all the major critical tasks. After a few iterations they had their Project Master Schedule (PMS), fully supported by critical path methodology. They did a forward and backward schedule pass to provide assurances that their PMS was viable. The project would take 18 months to perform from go-ahead to completion.

Lastly they estimated the resources required to produce these 10 units, which constituted the total project. Each article would cost $150,000 to produce, thus the total project would run $1.5 million dollars to complete. They charted their requirements as illustrated in Figure 1, which they termed their project management plan. This display would contain the three

Figure 1. *Project management plan.*

Work Breakdown Structure (WBS)

Project Master Schedule (PMS)

Tasks/Events	Jan.–Mar.	April–June	July–Sep.	Oct.–Dec.
Award	▲			
Design	▲			
Buy specifications		▲		
Vendor quotes		▲		
Purchase orders		▲		
Receive materials			▲	
Factory plans		▲		
Tool design		▲		
Tool fabrication		▲		
Parts fabrication			▲	
Assembly: sub & final			▲	
Test & checkout				▲
QC acceptance				▲
Article shipment				▲

Project Performance Display

$

time

critical elements of the plan: WBS, PMS, and a project performance display graph. Each element was supported by detailed break-outs. This process is typically called bottoms-up planning. The team had done its job; it was now time for the project manager to take its plan to the CEO for her approval.

Management's Approval

The project manager made a copy of the project management plan and gave it to the CEO's secretary so the CEO could review it prior to the approval meeting. When he was at last able to meet with the CEO, it was obvious that she had thoroughly read the entire plan; everything was marked and color coded. He hoped she liked what she had read.

The CEO opened on a positive note. *"This is the finest internal project management plan I have ever seen as head of this company, and we will use it as a model for all our future projects to follow."* The project manager was off to a good start.

"However, you must not have heard parts of my requirements. Time to market is most critical on this project, and you are projecting a casual schedule of 18 months. That is completely unacceptable. I need this project completed in not more that 12 months, can you handle that?" The young man took a deep breath.

"Of course we can," he said. He had no clue as to how he would do this, but the message from on high was becoming pretty clear.

"Also, I think you have gold-plated this job at a cost of $1.5 million, that also is unacceptable!" The boss was relentless. *"The most I could allocate for this project would be $1 million; we are not a big company, I have other commitments. Can you handle that?"*

The young project manager was beginning to understand why she had become CEO at such an early age . . . she was one tough person to deal with. Without hesitation the young man accepted the budget dictate.

The CEO realized that she had come down pretty hard on the young man and wanted to provide some consoling words before he left.

"Again I want to emphasize that this is the best project plan I have ever seen in this company. It will be our model for others to follow." Her words were some comfort, although the project manager was starting to worry about what he would say to the other members of his team. Their buy-in was essential to him.

As he was leaving the office the CEO said, *"I am very pleased that you are going to employ earned value measurement on this project. I would like to review your performance each quarter, at say three months into your 12-month project."*

"She never lets up," was the thought that raced through his mind. *"What do I tell the others?"*

Welcome to the World of Project Management

Let us stand back from this story and try to assess what took place. A project team met and developed a thorough, comprehensive project plan, with sufficient supporting data and schedule metrics so they could measure their earned value performance from start to completion. In particular, they had scoped

100 percent of the total assumed project before they would begin to perform and created a plan that could be measured. Good.

Their supporting bottoms-up detail indicated that they needed 18 months to complete the project, and the boss directed them to do it in 12 months. They estimated the costs for the project at $1.5 million and the boss cut it to $1 million. What do we call this kind of an environment the young project manager experienced for the first time? We call it real-life project management.

Rarely do we ever get the total time we think we need to reasonably perform the job. We are always competing with others to do something first. The authorized budgets are rarely what we estimate we need to complete any job. We frequently are given what has been termed "a management challenge" and we do our best. It matters not if these management challenges are arbitrary, unreasonable, unattainable, unrealistic, stupid, and so forth. As project managers, we must find a way to get it done.

Welcome to the world of project management.

The First Quarterly Project Status Review

Three months went by. It was time for the team to present its performance results to the chief executive and the management committee. This would be an awesome new experience for the young project team, but working in its favor was the fact that the team was performing to a detailed plan, and knew exactly what it had to do from the go-ahead.

A brief summary of the team's results indicated the following: Three units had been scheduled for completion at the three-months point, but only two were accomplished, thus members were slightly behind their planned schedule. They had forecasted expenditures of $300,000 and had committed $300,000, so they were right on their funding profile. An optimistic person could easily paint a positive picture of this project.

"We are a little behind schedule, we are right on our spend plan; leave us alone and life will be good," would be the spin put on these results by most practitioners.

However, the chief executive had specifically asked that this project employ earned value project management, and that requires a slightly different orientation with these same project performance data. Earned value management requires a detailed, bottoms-up performance plan, measurement taken against one's own plan, and a periodic forecast of the final expected results, based on actual performance results. Earned value requires detailed measurement against the project plan. In order to employ earned value, there must be a plan in place that allows the continuous measure of seven points of data. This may sound complicated and cumbersome, but it is not. It is simply the kind of data most projects have, but it may not be looked at in quite the same way. Earned value has a focus on its percent complete position against its (100 percent) defined scope.

In order to employ earned value, we must first know at all times what the planned value is as of any point in time[1]. To determine this we need to focus on two issues.

We must determine (1) how much physical or intellectual work we have scheduled to be completed. This is a direct fallout of those detailed tasks contained in our PMS. (Important point: Earned value requires a master project schedule; without a master project schedule one cannot perform earned value management.) In this case the PMS described three units to be accomplished as of the measurement period.

We need to determine (2) the budgeted value of the work scheduled. We were authorized $100,000 per unit, so our budgeted value for work scheduled was $300,000. Thus, we have set our planned value for the first three months of the project at $300,000[2].

Next we will want to measure our earned value for the reporting period. To measure this we need two new points of data, which we will call items (3) and (4).

As of the reporting period, (3) how much of our scheduled work have we actually accomplished? We examine our PMS and find that we have accomplished two of the three units we originally scheduled.

Next, (4) what is the budgeted value of the work actually performed? In this case we were authorized $100,000 per unit, so our earned value for the reporting period is $200,000. (Never mind actual costs at this point, they will only confuse the issue.) Thus, items three and four constitute our earned value for the period[3].

The next item we need to determine is, for the earned value work we have accomplished, (5) what costs have we actually spent and/or incurred? We look at our cost ledger and find we have incurred actual costs of $300,000.

We now have our earned value results for the first quarter, quantified in dollars, and a performance pattern is starting to emerge:

Planned Value —   *$300,000 (items 1 and 2)*
Earned Value —   *$200,000 (items 3 and 4)*
Actual Costs —   *$300,000 (item 5)*

We now need to ascertain our project performance variances, which is a slightly different look at data with earned value measurement.

We need to understand (6) the schedule variance, which in earned value is the difference between our planned value scheduled and our earned value achieved. In this case, we planned to accomplish $300,000 of work, but only did $200,000, so we are behind our planned schedule by $100,000. Not so bad until we realize that we only accomplished 67 cents for each dollar we planned to do.

Lastly, we need to know (7) what our cost variances have been. This is determined by relating our earned value accomplished against the actual costs spent or incurred. Thus, we spent $300,000 in actual costs to accomplish $200,000 in earned value. Not so good when we realize that for each dollar we spent we got only 67 cents of value earned.

The team put the results of its earned value performance on a display chart for presentation to the management committee, as is illustrated in Figure 2. Not a pretty sight, but one of
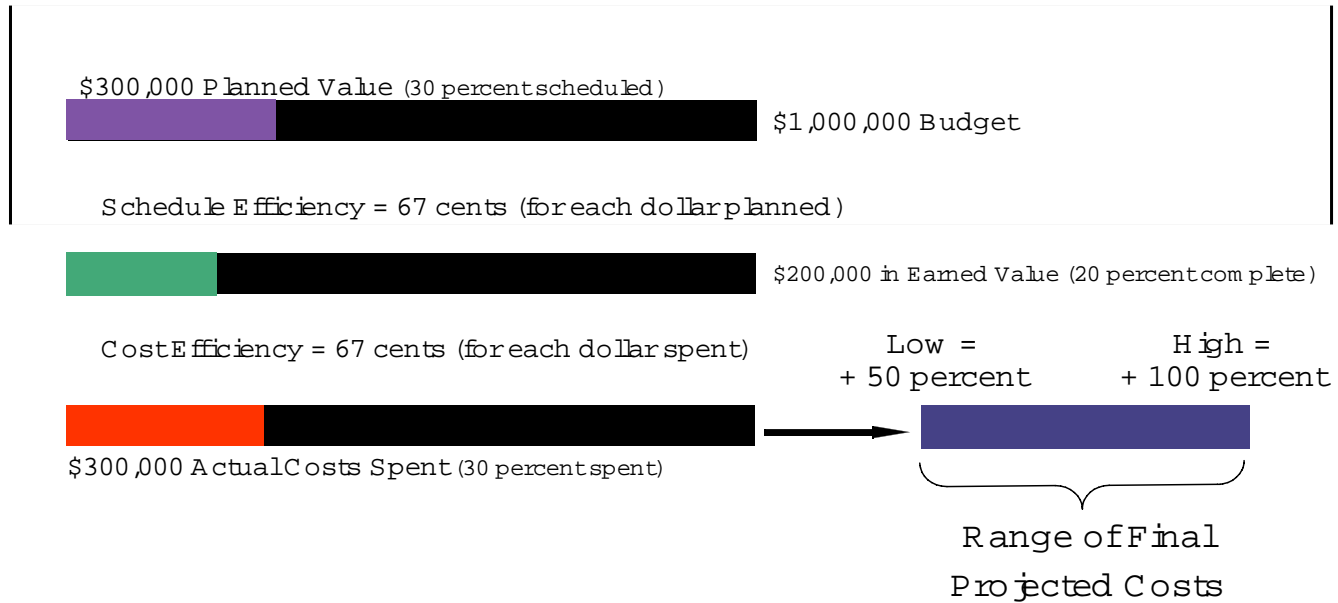
$300,000 Planned Value (30 percent scheduled)

$1,000,000 Budget

Schedule Efficiency = 67 cents (for each dollar planned)

$200,000 in Earned Value (20 percent complete)

Cost Efficiency = 67 cents (for each dollar spent)

Low =
+ 50 percent

High =
+ 100 percent

$300,000 Actual Costs Spent (30 percent spent)

Range of Final
Projected Costs

Figure 2. *Earned value performance results.*

extreme importance in the portrayal of the true status of project performance. This project at the end of the first quarter is behind its planned schedule, and is overrunning its costs. At the 20 percent completion point, monitoring earned value data, it is forecasting a significant final overrun.

If the project continued at its present cost efficiency rate of 67 cents for each dollar spent, it would need 50 percent more budget to complete the work ($1,000,000 / .67 equals $1,500,000). If it also tries to get back on the 12-month schedule, it will have to add additional resources to do the same work, so the projected costs would equate to a 100 percent overrun.

Most people do not like to hear bad news. But this chief executive knew that bad news does not improve with time, it only gets worse. At issue: Bad news known at the 20 percent point in a project's lifecycle gives management some opportunity to take corrective actions and alter the final results.

Conversely, bad news that is ignored or not addressed until perhaps the 80 percent completion point severely limits management's opportunities to make the necessary changes to recover performance.

This was exactly the kind of display the CEO wanted to see on this most critical project. She now declared, *"Thank you for this presentation; it has been most informative. I now know I was perhaps a little too arbitrary in my initial budget authorization to you. I will authorize you a revised budget amount of $1.5 million to complete this project."*

"Thank you," was the surprised response from the young project manager. He knew that the team needed at least that amount to complete this project.

(One of the primary reasons earned value results become so reliable at the early phases of a project's lifecycle — at the 15 percent to 20 percent point — rests on the human nature side

of the planning process. If one has a period of project performance extending one full cycle, where will you likely place your best planning — in the early periods or in the later periods? Likely in the early periods, and hope for the best in the later periods. Also, if one has a severe budget challenge, where will the most adequate budget be distributed— in the early or late periods of the project? Likely in the early periods. It is human nature to provide the best planning and the best resources to the early periods, and hope for the best. Thus, the results of earned value performance measurement have been found to be most reliable, even at the early periods, say 15 percent, of the lifecycle of a project.)

But the CEO was not going to let anyone off the hook just yet.

"However, I want you to catch up on the late schedule position, and bring us a completed project in another nine months. Can you do that?"

"Yes we can, but it will take an accelerated schedule, and that will likely cost us the full $2 million as we have presented to you," (see Figure 2), was the project manager's reply.

"OK, I will authorize this project a total budget of $1.5 million but ask that you complete it within the 12-month schedule," the CEO directed. *"However, as we both well know, to recover this behind-schedule condition will likely cost us some money, so I will put $500,000 in my management reserve in case we need it. But it is not your money and we want you back on schedule. Am I making myself clear?"* said the CEO.

"Absolutely clear, and we promise to do the best we can for the authorized budget," said the project manager.

"But getting back on schedule is your main performance objective, and the budget goal is simply my management challenge to you. Understand, the schedule comes first," was the CEO final comment.

"Understood," said the young project manager, who was beginning to appreciate the delicate role he was playing.

The Value of Earned Value

Standing back from this situation, we see that this project was likely under-budgeted (at $1 million) from the start. But based on what was authorized and what the project performance was experiencing, the likely final forecast of budget needs was in the statistical range of between $500,000 to $1 million over the official budget. Both the project manager and the CEO clearly understood that fact. But the CEO was not ready to relax her management challenge to this team. She released an additional half a million dollars to the project, but asked that they also get back on schedule. Getting back on schedule would cost additional resources, and likely require the full million dollars to achieve. But she was not ready to authorize the full amount.

This chief executive knew the benefits of employing earned value. She believed the accuracy of data that was being reviewed by the project team and the final projections of required costs. At the 20 percent completion point the team was predicting an overrun of between 50 percent to 100 percent, and she was convinced that this would be the case. In order to fund the completion of this critical project, she took immediate steps to cancel two other internal projects of lesser value to the company. She knew what she had to do in order to fully fund this highest priority project. Other executives who do not employ earned value or do not rely on the performance data often find themselves overly committed in their project portfolios, sometimes experiencing catastrophic results.

This project was completed on time, within the 12-month schedule, but at a final cost of close to $2 million. The new product worked as hoped, and the additional funds to complete the project were made available by the CEO canceling two other projects of lesser importance to the company.

Life was good at this company, and the young project manager's career was off to a good start. ◆

About the Authors

Quentin W. Fleming, senior staff consultant to Primavera Systems Inc., has more than 30 years industrial project management experience. He held various management assignments with the Northrop Corp. from 1968-91, served on an earned value corporate review team, and wrote the corporate policy directive on scheduling.

He was president of the Orange County Project Management Institute (PMI) chapter and developed and taught four PMI Project Management Professional tutorial courses covering scope, cost, time, and procurement management. He has a bachelor's and a master's degree in management and is the author of seven published textbooks, including *Earned Value Project Management*, which he co-wrote with Joel M. Koppelman.

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Notes

1. The Department of Defense (DoD) has called this the Budgeted Costs for Work Scheduled (BCWS) for three decades, but we choose to call it simply the Planned Value.
2. The fact that we originally estimated that each unit would require $150,000 to accomplish is only interesting to us. Management has authorized $100,000 per unit, and does not want to hear about other issues.
3. The DoD typically has called this the Budgeted Costs for Work Performed, or BCWP.